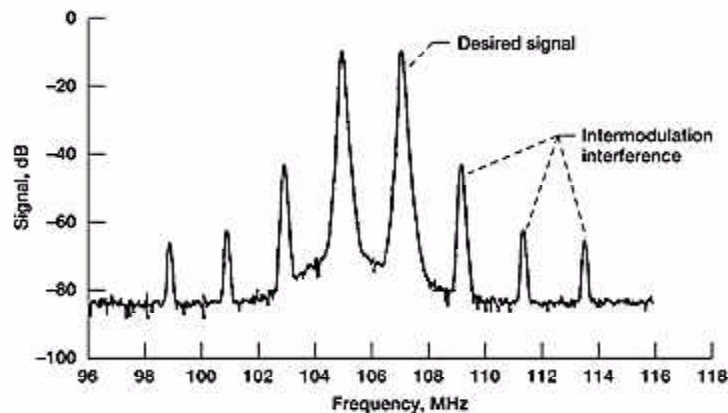
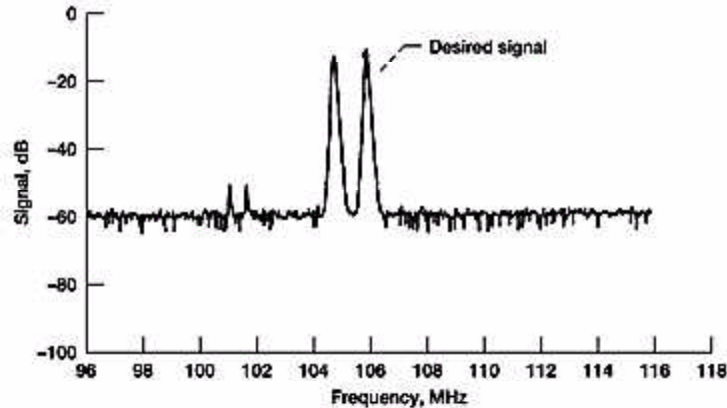


Silicon Carbide Mixers Demonstrated to Improve the Interference Immunity of Radio-Based Aircraft Avionics

Concern over the interference of stray radiofrequency (RF) emissions with key aircraft avionics is evident during takeoff and landing of every commercial flight when the flight attendant requests that all portable electronics be switched off. The operation of key radio-based avionics (such as glide-slope and localizer approach instruments) depends on the ability of front-end RF receivers to detect and amplify desired information signals while rejecting interference from undesired RF sources both inside and outside the aircraft. Incidents where key navigation and approach avionics malfunction because of RF interference clearly represent an increasing threat to flight safety as the radio spectrum becomes more crowded.

In an initial feasibility experiment, the U.S. Army Research Laboratory and the NASA Lewis Research Center recently demonstrated the strategic use of silicon carbide (SiC) semiconductor components to significantly reduce the susceptibility of an RF receiver circuit to undesired RF interference. A pair of silicon carbide mixer diodes successfully reduced RF interference (intermodulation distortion) in a prototype receiver circuit by a factor of 10 (20 dB) in comparison to a pair of commercial silicon-based mixer diodes.





Received signal spectrum. (Attenuation 10 dB; RL 0 dBm.) Top: Conventional silicon-diode mixer circuit. Bottom: SiC-diode mixer circuit--note the absence of intermodulation interference peaks.

This can be seen by comparing the received signal spectrums from a conventional silicon-diode mixer test circuit (top figure) with the received signal spectrum of an SiC-diode mixer circuit (bottom figure). The two largest peaks in the middle of both spectrums are the desired radio signals, which normally would contain avionics-related information. The peaks to either side of the desired signal in the top figure represent undesired intermodulation distortion signals, which can interfere with the proper detection and decoding of desired radio signals. The SiC-diode mixer circuit reduces these interference peaks to the point where they cannot be observed in the spectrum of the bottom figure. This circuit should enable aircraft avionics receivers to much more successfully extract weak desired information signals, even in the presence of strong undesired RF interference. Such circuits would clearly improve the reliability of flight-critical radio-based instrumentation, even if passengers continued to operate portable electronics during takeoffs and landings. Furthermore, aviation-related RF transmitters and receivers could be located closer to each other (both in the air and on the ground) without severe interference penalties.

Manufactured in volume, these simple-to-produce SiC mixers should cost around \$10 to \$20 each, well below the \$1000 it presently costs to achieve the same degree of RF interference immunity from complex, series-matched mixer hybrid circuits.

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